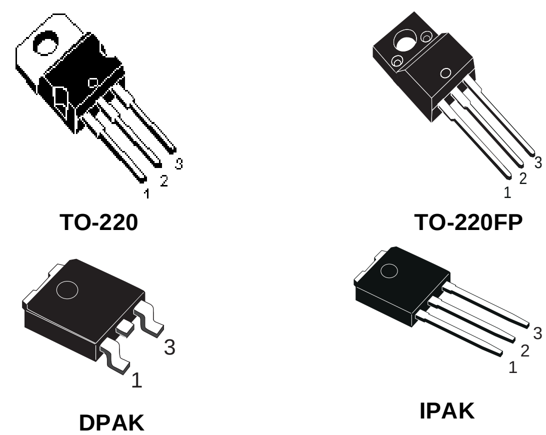
STP7NK40Z - STP7NK40ZFP
STD7NK40Z - STD7NK40Z-1

N-CHANNEL 400V-0.85Ω-5.4A TO-220/TO-220FP/DPAK/IPAK
Zener-Protected SuperMESH™Power MOSFET

TYPE	V_{DSS}	$R_{DS(on)}$	I_D	P_W
STP7NK40Z	400 V	< 1 Ω	5.4 A	70 W
STP7NK40ZFP	400 V	< 1 Ω	5.4 A	25 W
STD7NK40Z	400 V	< 1 Ω	5.4 A	70 W
STD7NK40Z-1	400 V	< 1 Ω	5.4 A	70 W

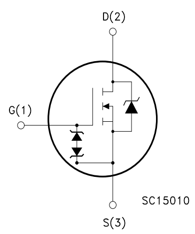
- TYPICAL R_{DS}(on) = 0.85 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY



DESCRIPTION

The SuperMESH™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MDmesh™ products.

INTERNAL SCHEMATIC DIAGRAM



APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR OFF-LINE POWER SUPPLIES, ADAPTORS AND PFC
- LIGHTING

ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STP7NK40Z	P7NK40Z	TO-220	TUBE
STP7NK40ZFP	P7NK40ZFP	TO-220FP	TUBE
STD7NK40ZT4	D7NK40Z	DPAK	TAPE & REEL
STD7NK40Z-1	D7NK40Z	IPAK	TUBE

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value			Unit
		STP7NK40Z	STP7NK40ZFP	STD7NK40Z STD7NK40Z-1	
V_{DS}	Drain-source Voltage (V_{GS} = 0)	400			V
V_{DGR}	Drain-gate Voltage (R_{GS} = 20 kΩ)	400			V
V_{GS}	Gate- source Voltage	± 30			V
I_D	Drain Current (continuous) at T_C = 25°C	5.4	5.4 (*)	5.4	A
I_D	Drain Current (continuous) at T_C = 100°C	3.4	3.4 (*)	3.4	A
I_{DM} (•)	Drain Current (pulsed)	21.6	21.6 (*)	21.6	A
P_{TOT}	Total Dissipation at T_C = 25°C	70	25	70	W
	Derating Factor	0.56	0.2	0.56	W/°C
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5KΩ)	3000			V
dv/dt (1)	Peak Diode Recovery voltage slope	4.5			V/ns
V_{ISO}	Insulation Withstand Voltage (DC)	-	2500	-	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	-55 to 150 -55 to 150			°C °C

(•) Pulse width limited by safe operating area
(1) I_{SD} ≤5.4A, di/dt ≤200A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_j ≤ T_{JMAX}.
(*) Limited only by maximum temperature allowed

THERMAL DATA

		TO-220	TO-220FP	DPAK IPAK	
Rthj-case	Thermal Resistance Junction-case Max	1.78	5	1.78	°C/W
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5		100	°C/W
T_l	Maximum Lead Temperature For Soldering Purpose	300			°C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	5.4	A
E_{AS}	Single Pulse Avalanche Energy (starting T_j = 25 °C, I_D = I_{AR}, V_{DD} = 50 V)	130	mJ

GATE-SOURCE ZENER DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-Source Breakdown Voltage	Igs=± 1mA (Open Drain)	30			V

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED)
ON/OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	I_D =1 mA, V_{GS} = 0	400			V
I_{DSS}	Zero Gate Voltage Drain Current (V_{GS} = 0)	V_{DS} = Max Rating V_{DS} = Max Rating, T_C = 125 °C			1 50	µA µA
I_{GSS}	Gate-body Leakage Current (V_{DS} = 0)	V_{GS} = ± 20V			±10	µA
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 50µA	3	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{GS} = 10V, I_D = 2.7 A		0.85	1	Ω

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{DS} =15 V, I_D = 2.7 A		3.5		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{DS} = 25V, f = 1 MHz, V_{GS} = 0		535 82 18		pF pF pF
$C_{oss\ eq.}$ (3)	Equivalent Output Capacitance	V_{GS} = 0V, V_{DS} = 0V to 400V		53		pF

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r	Turn-on Delay Time Rise Time	V_{DD} = 200 V, I_D = 2.7 A R_G = 4.7Ω V_{GS} = 10 V (Resistive Load see, Figure 3)		15 15		ns ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	V_{DD} = 320V, I_D = 5.4 A, V_{GS} = 10V		19 4 10	26	nC nC nC

SWITCHING OFF

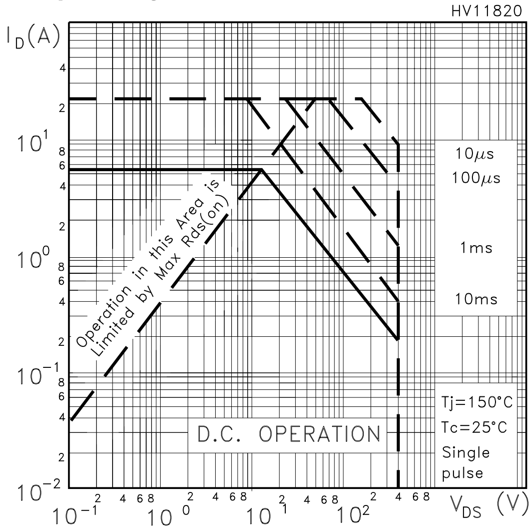
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ t_f	Turn-off Delay Time Fall Time	V_{DD} = 200 V, I_D = 2.7A R_G = 4.7Ω V_{GS} = 10 V (Resistive Load see, Figure 3)		30 12		ns ns
$t_{r(Voff)}$ t_f t_c	Off-voltage Rise Time Fall Time Cross-over Time	V_{DD} = 320V, I_D = 5.4A, R_G = 4.7Ω, V_{GS} = 10V (Inductive Load see, Figure 5)		12 10 20		ns ns ns

SOURCE DRAIN DIODE

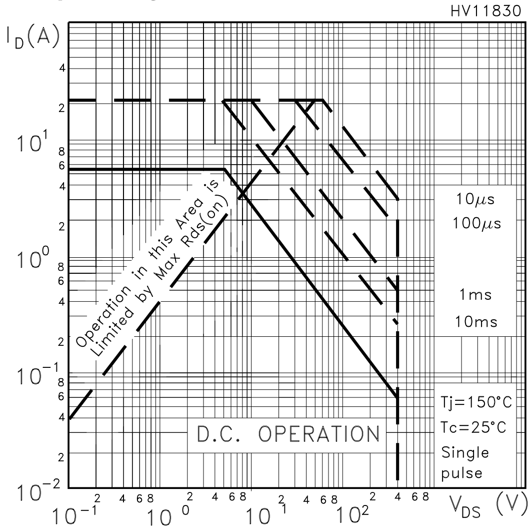
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} I_{SDM} (2)	Source-drain Current Source-drain Current (pulsed)				5.4 21.6	A A
V_{SD} (1)	Forward On Voltage	I_{SD} = 5.4 A, V_{GS} = 0			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD} = 5.4 A, di/dt = 100A/µs V_{DD} = 50V, T_j = 150°C (see test circuit, Figure 5)		220 990 9		ns nC A

Note: 1. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %.
2. Pulse width limited by safe operating area.
3. $C_{oss\ eq.}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS}.

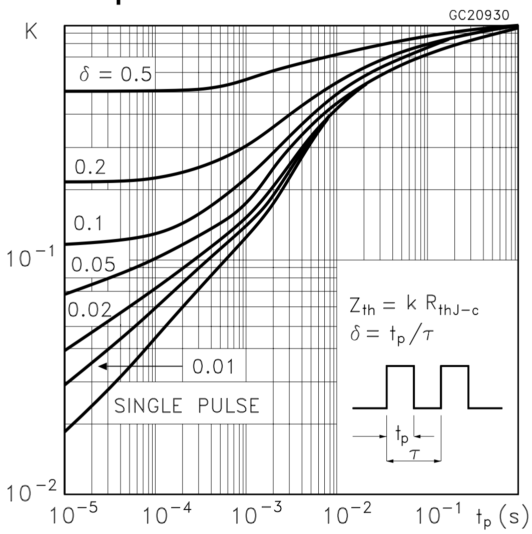
Safe Operating Area For TO-220/DPAK/IPAK



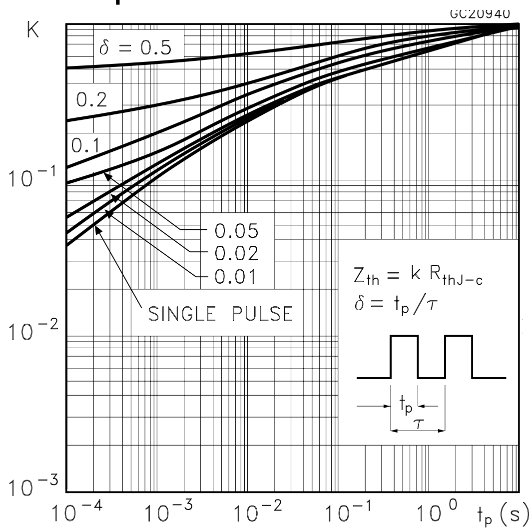
Safe Operating Area For TO-220FP



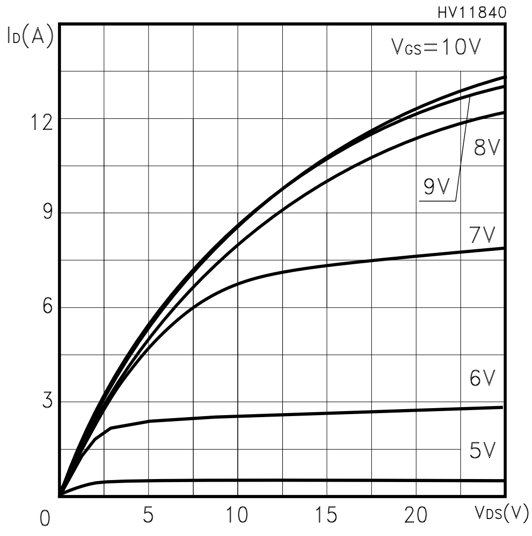
Thermal Impedance For TO-220/DPAK/IPAK



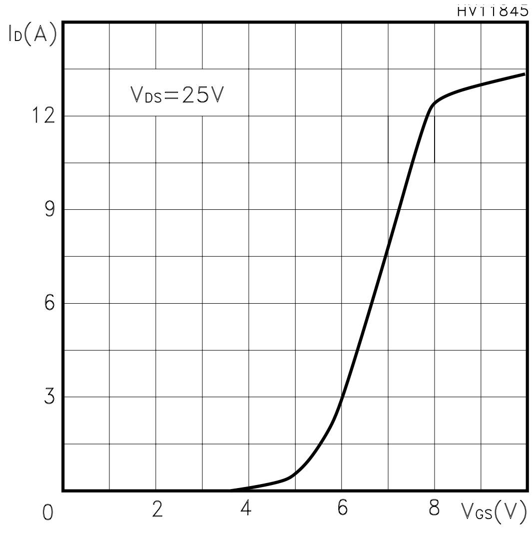
Thermal Impedance For TO-220FP



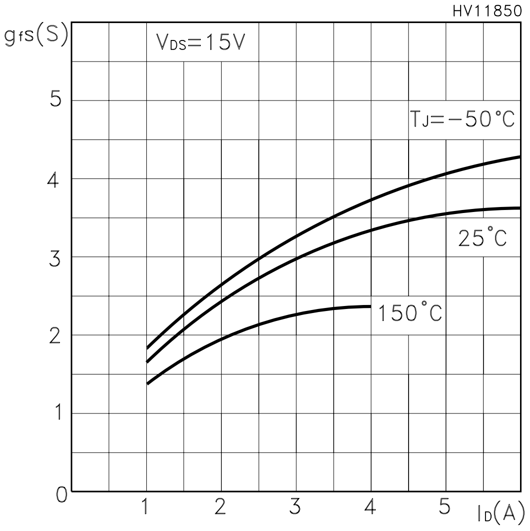
Output Characteristics



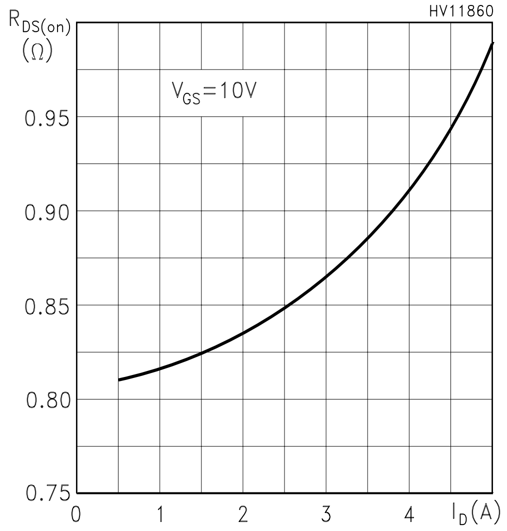
Transfer Characteristics



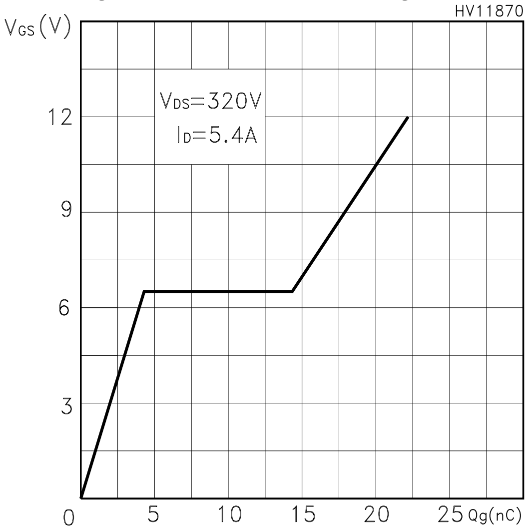
Transconductance



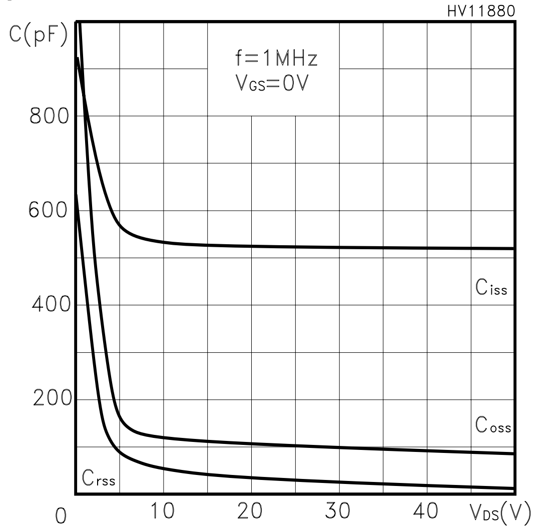
Static Drain-source On Resistance



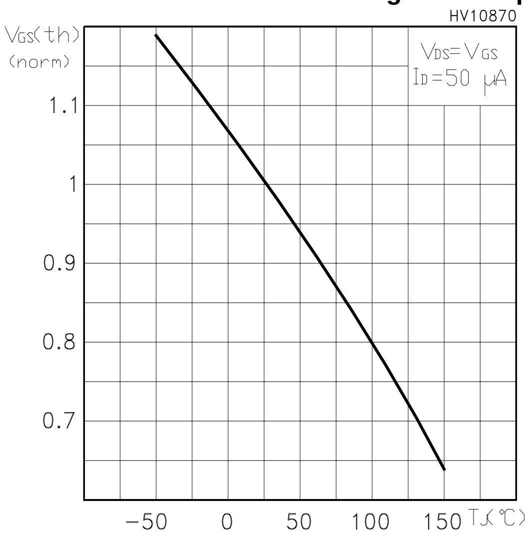
Gate Charge vs Gate-source Voltage



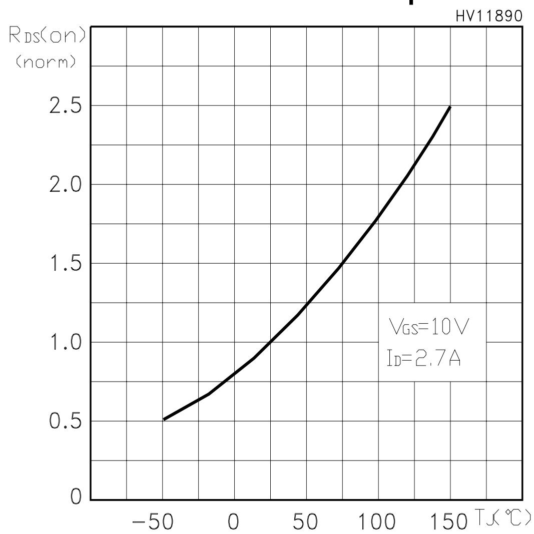
Capacitance Variations



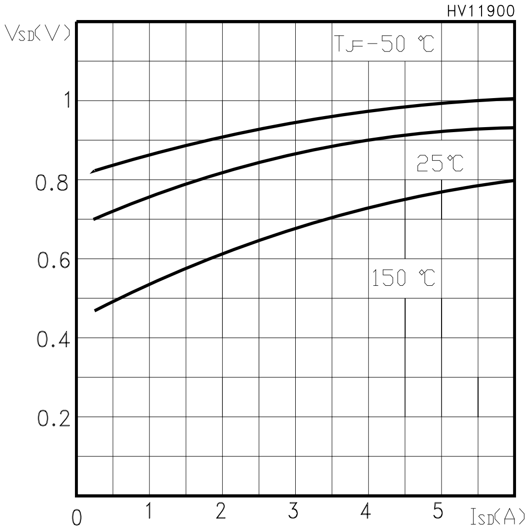
Normalized Gate Threshold Voltage vs Temp.



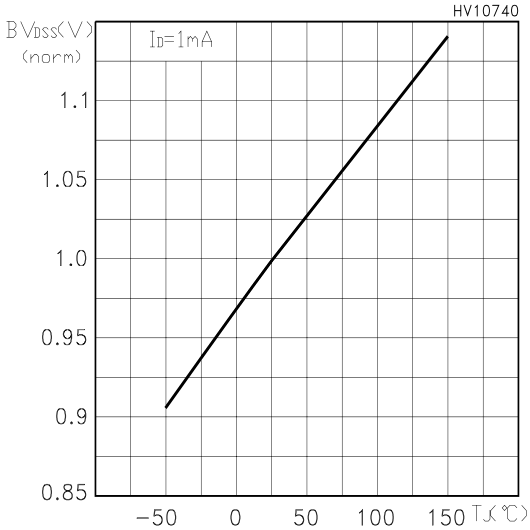
Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics



Normalized BVDSS vs Temperature



Maximum Avalanche Energy vs Temperature

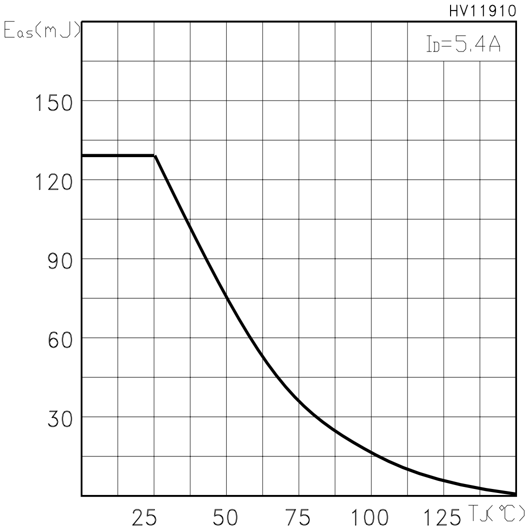


Fig. 1: Unclamped Inductive Load Test Circuit

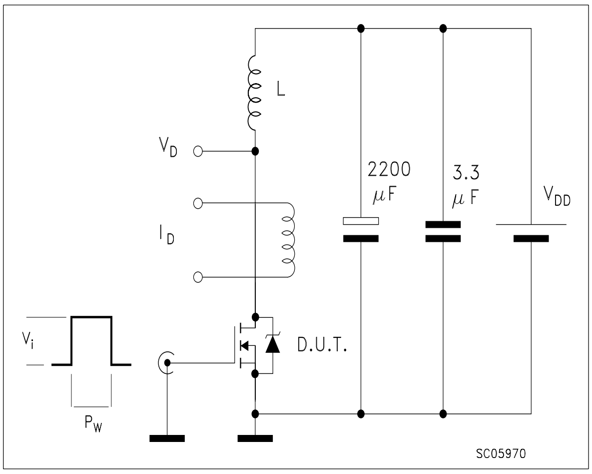


Fig. 2: Unclamped Inductive Waveform

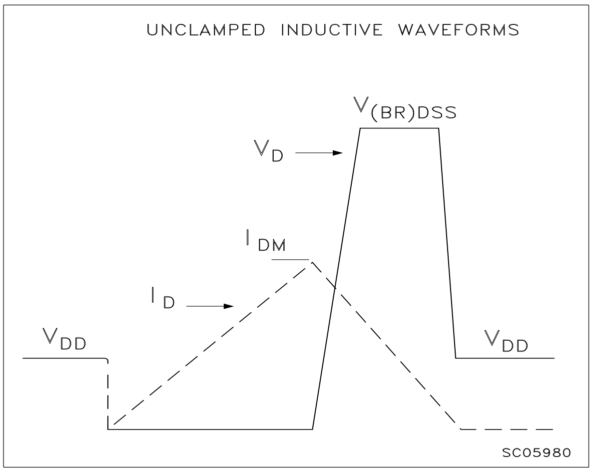


Fig. 3: Switching Times Test Circuit For Resistive Load

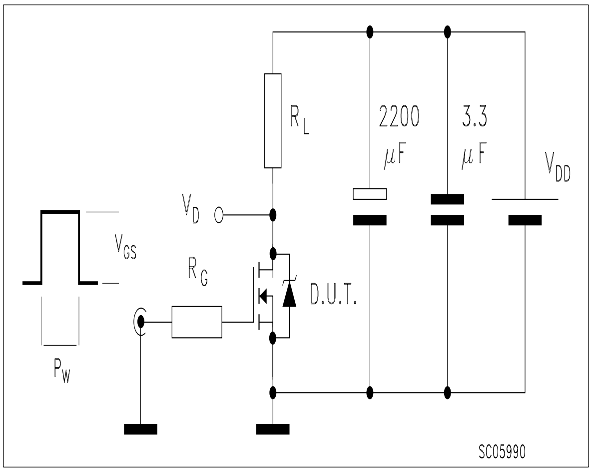


Fig. 4: Gate Charge test Circuit

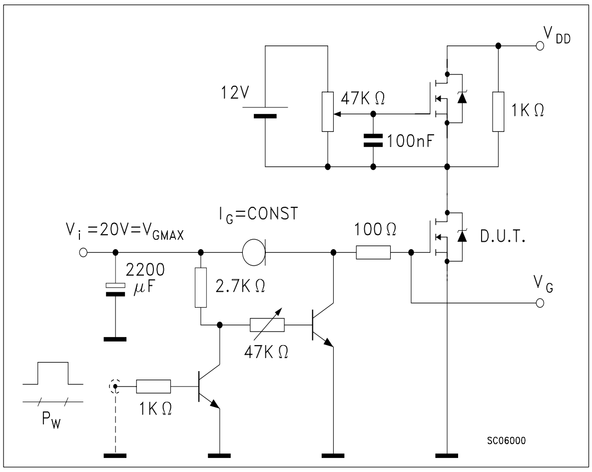
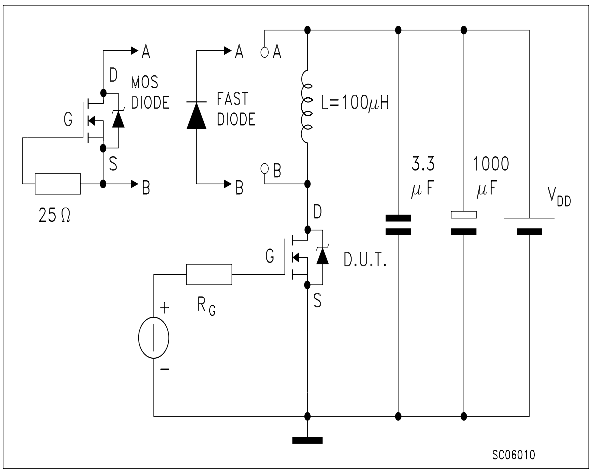
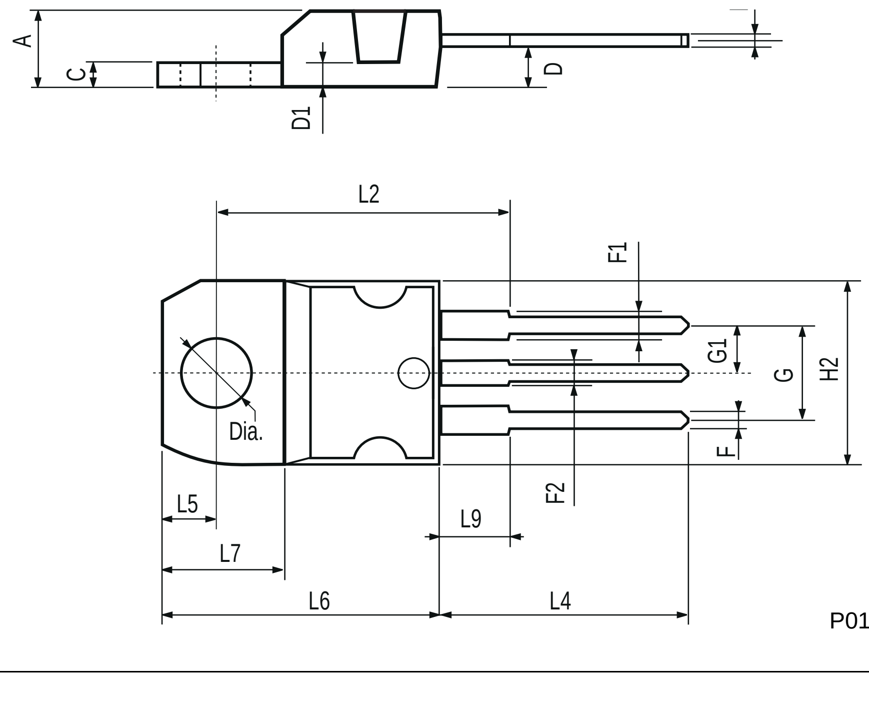


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



TO-220 MECHANICAL DATA

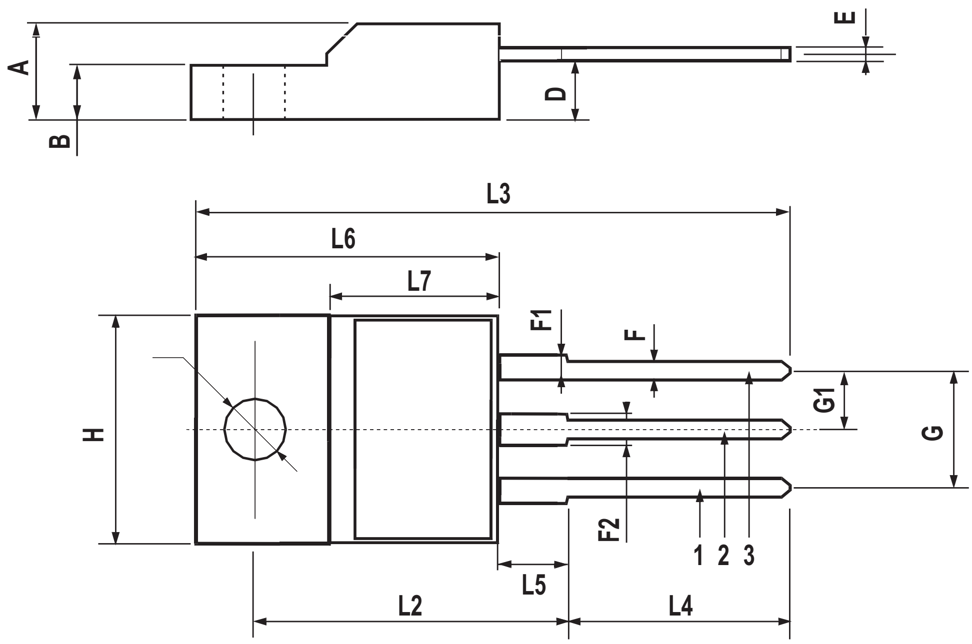
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



P011C

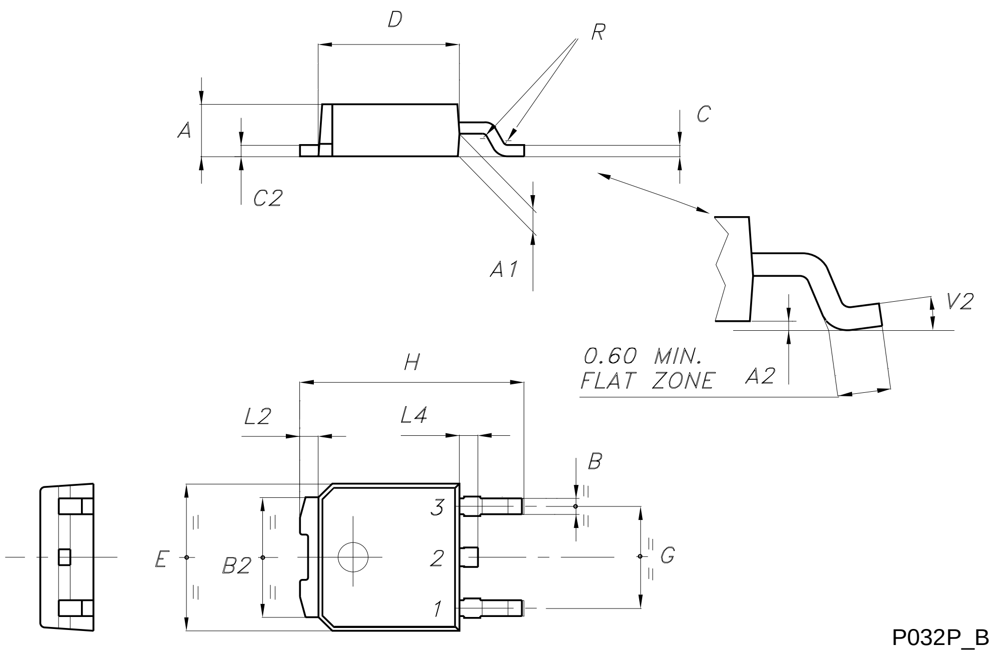
TO-220FP MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.5	0.045		0.067
F2	1.15		1.5	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126



TO-252 (DPAK) MECHANICAL DATA

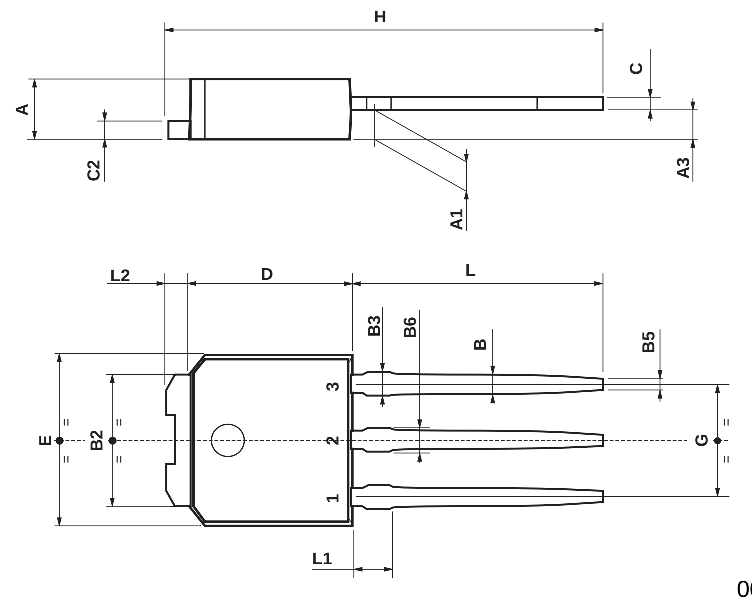
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°



P032P_B

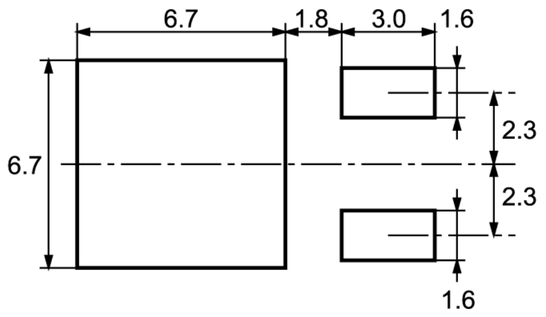
TO-251 (IPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



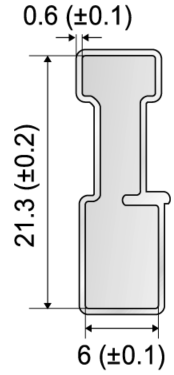
0068771-E

DPAK FOOTPRINT



All dimensions are in millimeters

TUBE SHIPMENT (no suffix)*



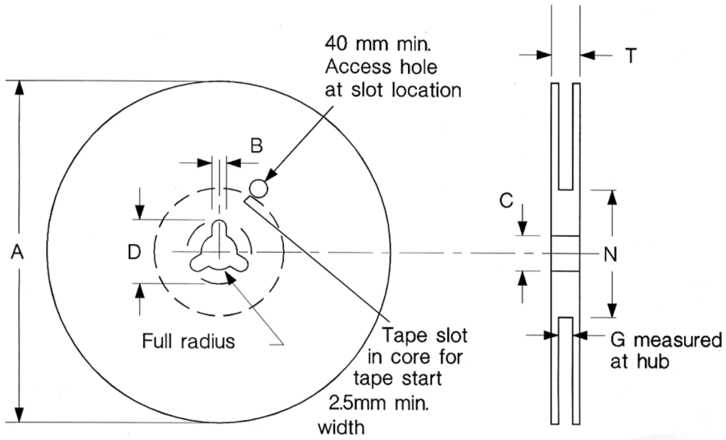
BASE QTY
75

BULK QTY
3000

Tube length 532 (±0.5)

All dimensions are in millimeters

TAPE AND REEL SHIPMENT (suffix ”T4”)*



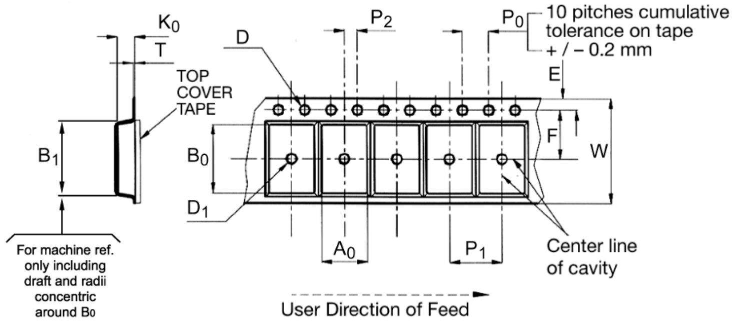
REEL MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

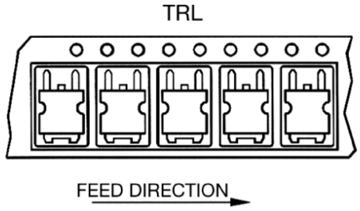
BASE QTY	BULK QTY
2500	2500

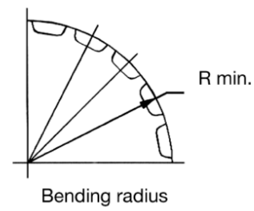
TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641



TRL





* on sales type